

## THREE NEW SPECIES OF STYLASTERIDAE (COELENTERATA: HYDROZOA)

Stephen D. Cairns

*Abstract.* — Three new species of stylasterid corals are described: a *Crypthelia* from the western Indian Ocean and two closely related species of *Lepidopora* from off New Zealand. Each of the three species has some unique character states which require a broadening of their respective generic diagnoses.

Stylasterid corals occur in all ocean basins from continental Antarctica to the Arctic Circle at depths between 0–2800 m; however, most of the approximately 200 species in the family (Cairns 1983b) occur at depths of 200–700 m. Because this environment is infrequently sampled, it is assumed that many of the stylasterid species remain to be collected and described. Based on recent faunistic revisions (Cairns 1983a; in press a, b), approximately half of the stylasterid species collected from deep water were undescribed. Every new collection thus affords an opportunity to describe and study new and often fascinating adaptations to the common requirements of life, such as defense and food getting. The description of new species, combined with new or previously unused methods of study (e.g., scanning electron microscopy, phylogenetic analysis, histological analysis, critical-point drying of decalcified tissue), are providing a greater understanding of stylasterid functional morphology as well as improving generic diagnoses and our knowledge of generic interrelationships.

The three new species described herein are of interest because they all require a modification of their respective generic diagnoses, which, in turn, should contribute in a small way to a subsequent evolutionary analysis of the family. The new species are members of the least derived genus, *Lepidopora*, and one of the most derived, *Crypthelia* (sensu Cairns 1984), and have several unique character states never before described for the stylasterids.

### Station Data

Station number	Latitude, south	Longitude, east	Depth, meters	Date
Anton Bruun 8-420A	2°42'	40°53'	140	6 Nov 1964
NZOI E305	34°10'	171°55'	282	9 Apr 1965
NZOI P458	34°13.8'	171°56.4'	200	Jun 1978
NZOI P544	34°09.9'	171°49.5'	290	Jun 1978
NZOI P559	33°59.8'	171°41.6'	197	Jun 1978
NZOI P561	33°58.0'	171°28.0'	506	Jun 1978
NZOI P566	33°56.1'	171°27.2'	514	Jun 1978

### *Lepidopora* Pourtalès, 1871

*Diagnosis.* — Coordination of gastro- and dactylopores usually lacking; however, in several species dactylopores are linearly arranged on branches in two or more

longitudinal rows. Coenosteal texture variable, including reticulate-granular, linear-granular, linear-imbricate, and tufted. Abcauline gastropore lip present in some species. Gastro- and dactylopore tubes long. Gastrostyles unridged, with a moderately high H:W ratio and with robust, simple spination. Dactylopores apically perforate cones or flush with coenosteum, sometimes linked by ridges; dactylostyles lacking. Ampullae usually superficial. Type-species: *Errina glabra* Pourtalès, 1867, by subsequent designation (Boschma 1963:336).

*Discussion.*—*Lepidopora* is the least derived (Cairns 1984) and most variable (Cairns 1983b) of the stylasterid genera. Almost every character in the generic diagnosis has a broad range of variation, and the species now assigned to the genus are undoubtedly a polyphyletic assemblage. Three characters, none of them unique to *Lepidopora*, help to distinguish the genus: apically perforate dactylopore mounds, unridged gastrostyles, and long dactylopore tubes. No other genus has this combination of characters.

The two new species of *Lepidopora* described herein also serve to broaden the generic definition. They both have internal ampullae, which heretofore had not been reported in *Lepidopora*, and they both have multiple longitudinal rows of dactylopores, a level of coordination not achieved by any of the other species in the genus.

*Lepidopora cryptocymas*, new species

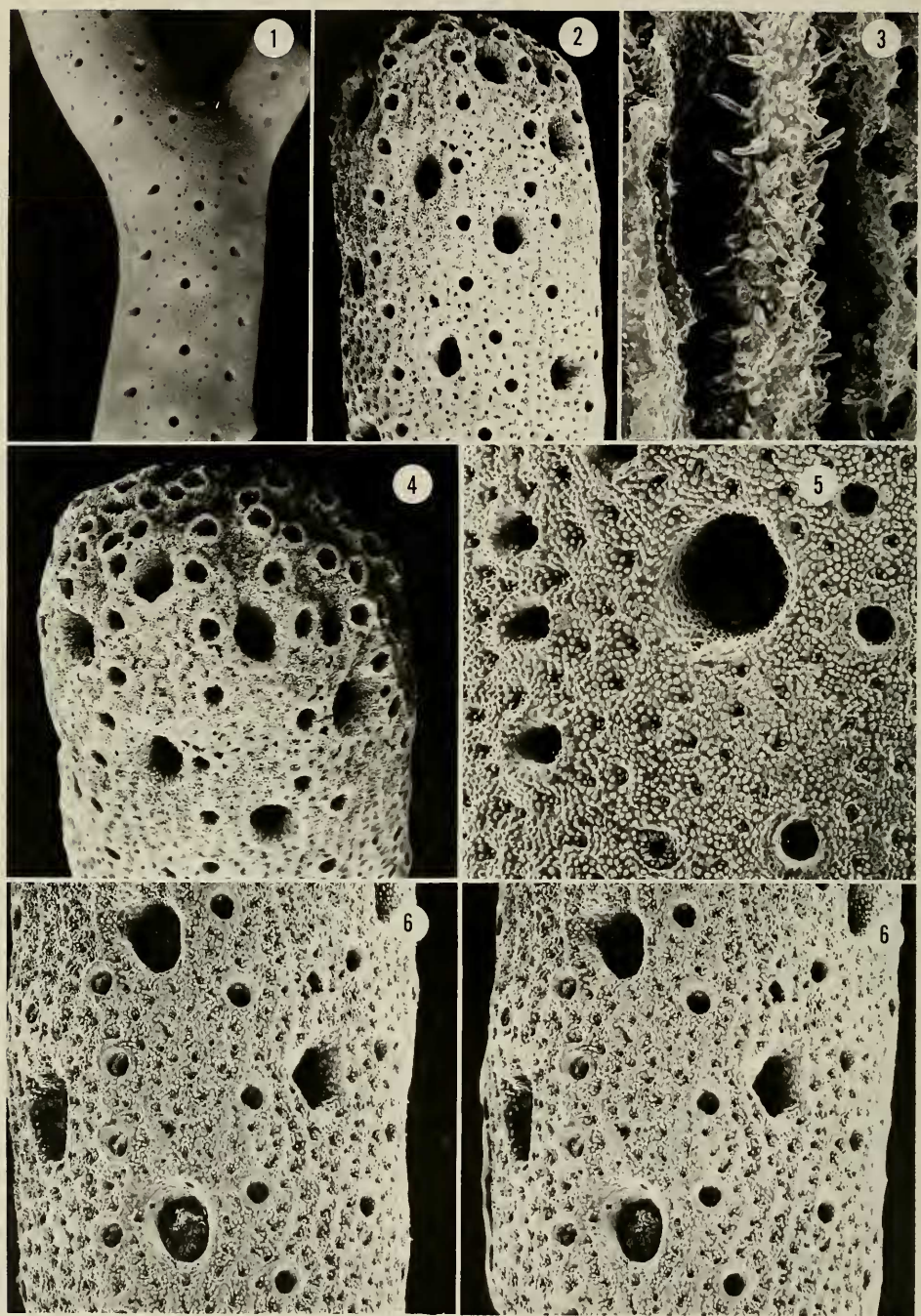
Figs. 1–11

*Description.*—Colonies uniplanar, the largest colony fragment (holotype) 27.6 mm tall and 5.3 mm in basal branch diameter. All branches cylindrical, distal branches about 3.0 mm in diameter. Branch axils U-shaped. Coenosteum white or yellowish brown, composed of longitudinal strips 0.11–0.14 mm wide, which are delimited by round to elongate coenosteal pores about 50  $\mu$ m in diameter. Strips and inner surfaces of coenosteal pores covered with broad, smooth, pointed spines 15–21  $\mu$ m tall and about 17  $\mu$ m in basal diameter.

Dactylopores aligned in straight to slightly meandering longitudinal rows, 6 to 8 rows around the circumference of a larger branch. Dactylopore rows delimit longitudinal bands of coenosteum, each band composed of 6 to 9 coenosteal strips. Gastropores aligned midway on coenosteal band defined by dactylopores, their centers 1.2–1.5 mm apart. Gastropores round to slightly elliptical, 0.35–0.40 mm in diameter, their tubes curving downward and running parallel to branch axis. Ring palisade and tabulae absent. Gastrostyles elongate and unridged. Styles about 0.10 mm in diameter and of indeterminate length (because the gastrostyles are so brittle none was exposed intact); however, H:W ratio estimated to be about 10. Styles covered by long, pointed, cylindrical spines up to 61  $\mu$ m long and about 15  $\mu$ m in diameter. Dactylopores round, about 0.12 mm in diameter, and flush with coenosteal surface, not elevated or linked by ridges. Dactylopores 0.2–0.6 mm apart.

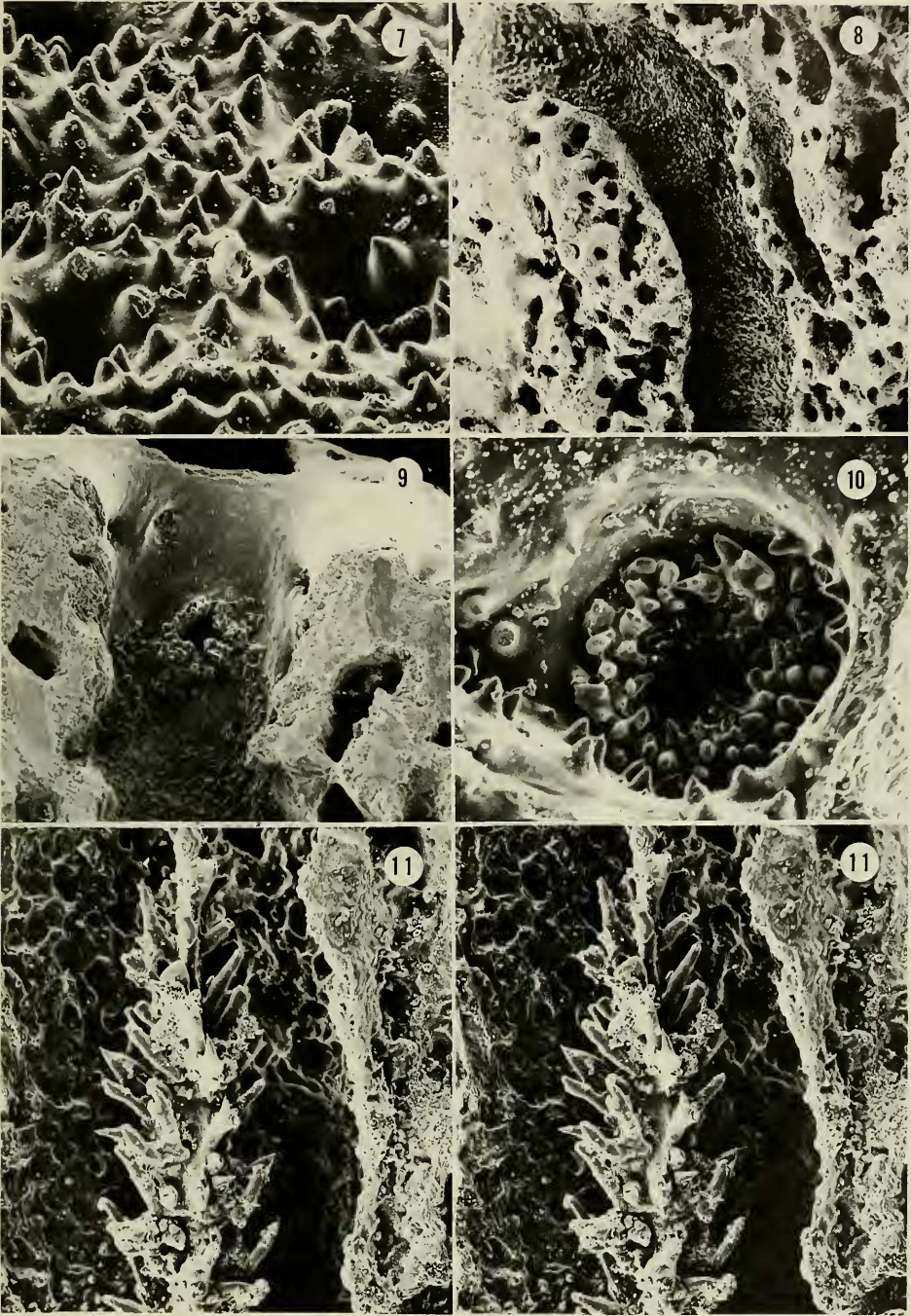
Female ampullae internal and ellipsoidal in shape, about 1.00  $\times$  0.60 mm in diameter. Each female ampulla located just distal to a gastropore, opening into gastropore tube via slender efferent canal and pore, which penetrates upper distal wall of gastropore tube (Fig. 9). Mature efferent pore about 0.15 mm in diameter. Male ampullae also internal, spherical, and about 0.5–0.6 mm in diameter. Male





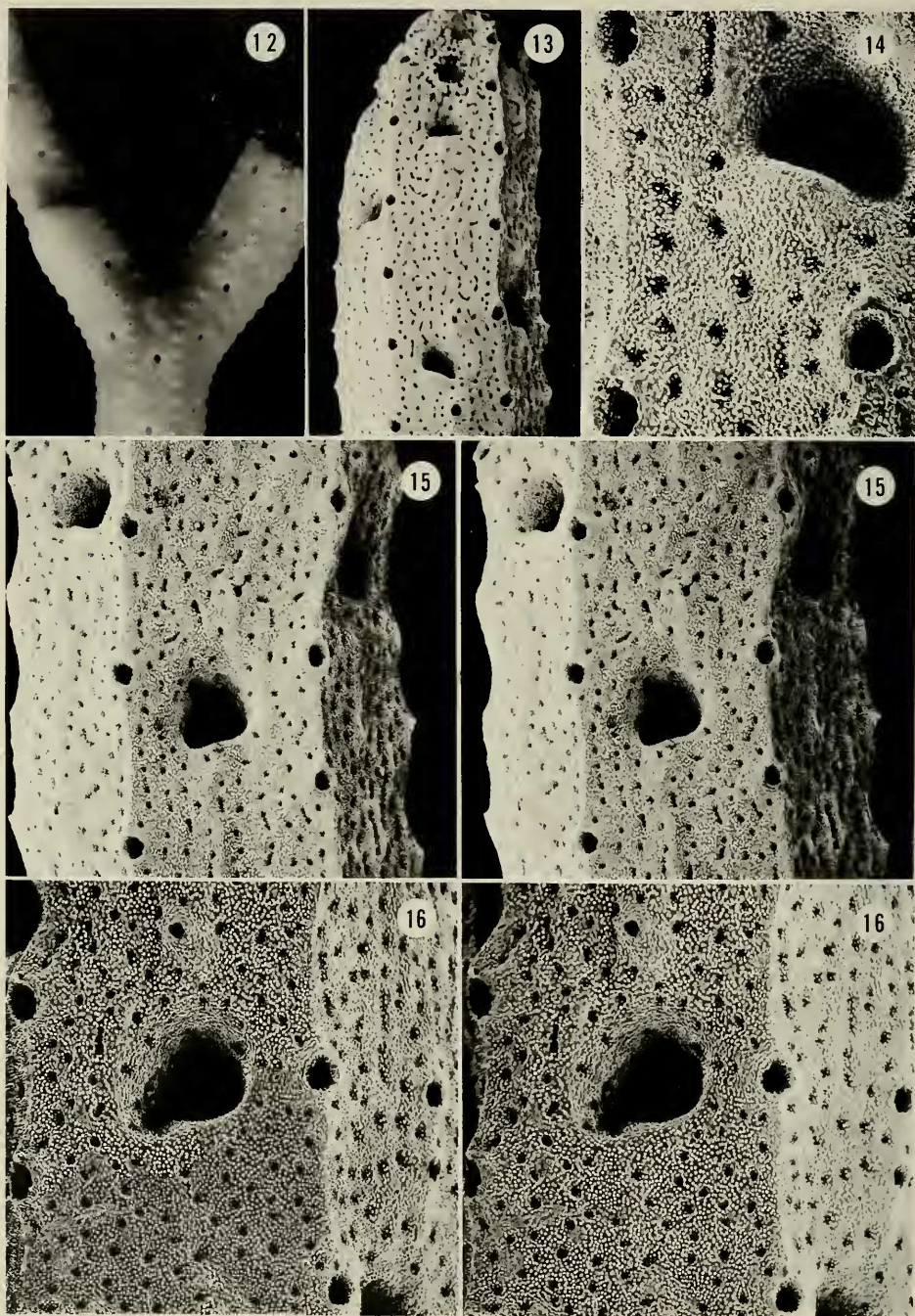
Figs. 1-6. *Lepidopora cryptocymas*. (1, Holotype; 2, 4, 6, paratype of unknown sex from NZOI P458; 3, 5, male paratype from NZOI E305): 1, Holotype colony,  $\times 4.0$ ; 2, 4, 6, Branch segments showing alignment of dactylopores,  $\times 15$ ,  $\times 21$ ,  $\times 23$ , respectively (Fig. 6 is a stereo pair); 3, Segment of gastrostyle,  $\times 105$ ; 5, Portion of coenosteum including four types of pores: one large gastropore, seven smaller dactylopores, numerous small coenosteal pores, and one recessed male efferent pore (lower center),  $\times 45$ .





Figs. 7–11. *Lepidopora cryptocymas*. (7–8, 10, male paratype from NZOI E305; 9, female paratype from NZOI P559; 11, paratype of unknown sex from NZOI P458): 7, Coenostomal granules,  $\times 295$ ; 8, Longitudinal section of curving gastropore tube (branch surface to left),  $\times 42$ ; 9, Aperture of female efferent pore opening into upper gastropore tube,  $\times 97$ ; 10, Male efferent pore,  $\times 265$ ; 11, Gastrostyle,  $\times 210$ , stereo pair.





Figs. 12–16. *Lepidopora polystichopora*. (12, Holotype; 13–16, male paratype from NZOI E305): 12, Holotype colony,  $\times 3.6$ ; 13, Branch tip,  $\times 14$ ; 14, Detail of coenosteum showing three dactylopores, and one larger gastropore with a small abcauline lip,  $\times 63$ ; 15–16, Distal branch coenosteum showing alignment and linkage of dactylopores, in both cases an elevated male efferent pore is present just above the central gastropore,  $\times 25$ ,  $\times 39$ , respectively (both are stereo pairs).

efferent pores 40–50  $\mu\text{m}$  in diameter, opening into shallow coenosteal depression about 0.12 mm in diameter and 40  $\mu\text{m}$  deep, located directly above ampulla.

*Discussion.* — *Lepidopora cryptocymas* is distinguished from the other eight species (Cairns 1983b) in the genus by its multiple, continuous, linearly arranged rows of dactylopores; its internal ampullae; and its very low, virtually flush, dactylopores. *Lepidopora glabra* (Pourtalès, 1867) has linearly arranged dactylopores, but they occur only on the lateral branch edges; in addition, there are many more differences between the two species regarding coenosteal texture and presence of ring palisades and gastropore lips (Cairns 1983b). *Lepidopora acrolophos* (Cairns 1983a), known only from off South Georgia, also has linearly arranged dactylopores; however, its dactylopore rows are short, and they often bifurcate and rejoin. Furthermore, *L. acrolophos* has superficial ampullae, a bushy corallum, and a very different coenosteal texture. Comparisons to the closely related *L. polystichopora* are made in the discussion of that species.

*Etymology.* — The specific name *cryptocymas* (Greek *cryptos* for “concealed” or “hidden” + *cymas* for “pregnant woman”) refers to the internal female ampullae, whose efferent pores are even hidden from view within the gastropore tube.

*Types.* — Holotype: NZOI E305, male, NZOI. — Paratypes: NZOI E305 (1 male, 1 sex indeterminate branches) USNM 72342, (2 male, 1 female, 3 sex indeterminate branches) NZOI; NZOI P458 (1 female, 1 sex indeterminate branches) USNM 72343, (3 female, 14 sex indeterminate branches) NZOI; NZOI P544 (1 branch, sex indeterminate) NZOI; NZOI P559 (1 female, 1 male branches) USNM 72345, (5 female, 1 male, 4 sex indeterminate branches) NZOI; NZOI P561 (1 female, 1 sex indeterminate branches) USNM 72346, (3 female, 13 sex indeterminate branches) NZOI. Type-Locality: 34°10'S, 171°55'E (west of Three Kings Island, New Zealand), 282 m.

*Distribution.* — Known only from west of Three Kings Island, New Zealand; 197–506 m.

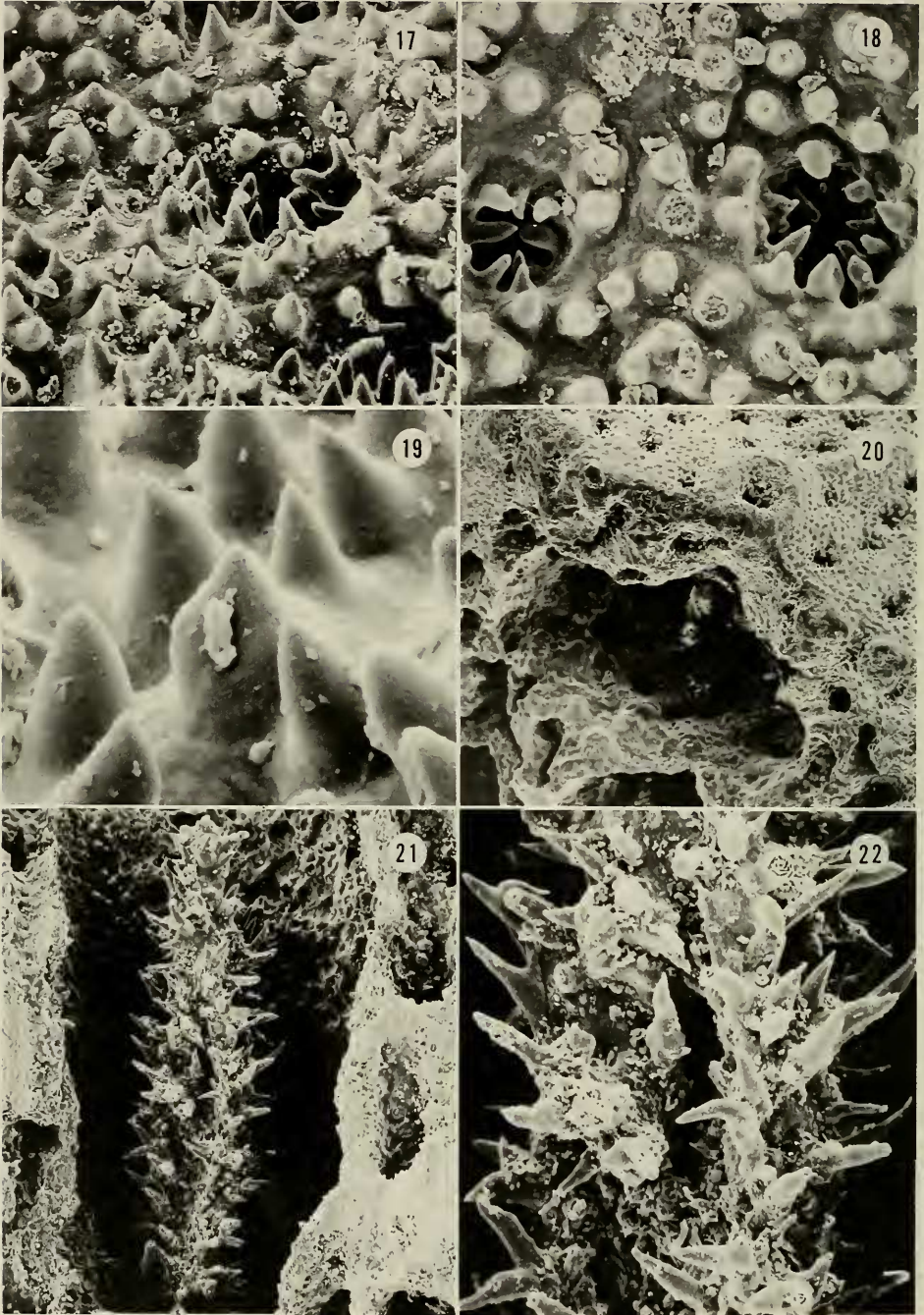
*Lepidopora polystichopora*, new species

Figs. 12–22

*Description.* — Colonies uniplanar, largest colony fragment (holotype) 20.5 mm tall and 4.0 mm in basal branch diameter. Distal branches strongly flattened, e.g.,  $2.9 \times 1.8$  mm, but larger diameter branches rounded. Branch axils U-shaped. Branch cross section consisting of larger diameter gastropore tubes surrounding central bundle of smaller diameter dactylopore tubes, both types of pores quite elongate. Coenosteum white, composed of longitudinal strips 0.10–0.12 mm wide, which are delimited by round to slightly elongate coenosteal pores 35–40  $\mu\text{m}$  in diameter. Strips and inner surfaces of coenosteal pores (Fig. 18) and inner surfaces of dactylopores densely covered with robust, smooth, sharp spines 10–13  $\mu\text{m}$  tall and about 7  $\mu\text{m}$  in basal diameter.

Dactylopores arranged in straight longitudinal rows, 6 or 7 rows around circumference of branch, which delimit longitudinal bands of coenosteum, each band composed of 6 to 9 coenosteal strips. Gastropores aligned midway on coenosteal bands defined by dactylopores, their centers 1.2–2.0 mm apart. Gastropores round to elliptical, 0.32–0.38 mm in diameter, some with very slight abcauline lip (Fig. 14), which alters shape of gastropore. Ring palisade and tabulae absent. Gastrostyles elongate and unridged. Styles about 0.085 mm in diameter and of indeter-





Figs. 17-22. *Lepidopora polystichopora*, male paratype from NZOI E305: 17, 19, Coenosteal granules,  $\times 530$ ,  $\times 1875$ , respectively; 18, Two coenosteal pores,  $\times 555$ ; 20, Cross section of male ampulla with intact efferent pore,  $\times 90$ ; 21-22, Gastrostyle,  $\times 155$ ,  $\times 465$ , respectively.

minate length; however, H:W ratios estimated to be about 10. Styles covered by elongate, tapered spines up to 36  $\mu\text{m}$  long and about 6  $\mu\text{m}$  in diameter at mid-height. Dactylopores round, 0.08–0.10 mm in diameter, and elevated about 0.12 mm. On distal branches, low ridges unite dactylopores, these ridges absent on larger diameter branches. Low ridges of same size sometimes also link gastropores. Dactylopores spaced about 0.40 mm apart.

Only one type of ampulla was noted: by analogy to the previously described species and based on the diameter of the efferent pores, presumably a male. Ampullae internal, 0.45–0.50 mm in diameter, communicating to surface by narrow efferent pore about 50  $\mu\text{m}$  in diameter, pore elevated on small mound about 0.16 mm in diameter and 0.07 mm tall. Efferent pores located about midway between dactylopore rows, sometimes up to three between adjacent gastropores.

*Discussion.*—*Lepidopora polystichopora* and *L. cryptocymas* are known from the same localities and are so similar that they are hypothesized to be sister species. Points of similarity include: colony shape, coenosteal texture, unique coordination of gastro- and dactylopores, and internal ampullae. They differ, however, in at least five ways. *Lepidopora polystichopora* has: 1) strongly flattened distal branches, not round in cross section, 2) small abcauline lips on some of the gastropores, 3) prominent dactylopores linked by ridges, producing a polygonal cross section of distal branches, not flush dactylopores as in *L. cryptocymas*, 4) shorter, more attenuate gastrostyle spines, and 5) male efferent pores elevated above the coenosteal surface, not ending in concavities as in *L. cryptocymas*.

*Etymology.*—The specific name *polystichopora* (Greek *polys* for “many” + *stichos* for “row” + *poros* for “pore”) refers to the multiple longitudinal rows of dactylopores.

*Types.*—Holotype: NZOI E305, male, NZOI.—Paratypes NZOI E305 (1 male fragment) USNM 72348, (1 male) NZOI; NZOI P458 (1 male branch) NZOI; NZOI P559 (1 branch, sex indeterminate) NZOI; NZOI P561 (1 branch, sex indeterminate) NZOI; NZOI P566 (1 branch, sex indeterminate) USNM 72352, (1 branch, sex indeterminate) NZOI. Type-Locality: 34°10'S, 171°55'E (west of Three Kings Island, New Zealand), 282 m.

*Distribution.*—Known only from west of Three Kings Island, New Zealand; 197–514 m.

### *Crypthelia* Milne Edwards and Haime, 1849

*Diagnosis.*—Gastro- and dactylopores arranged in cyclosystems, which occur exclusively on anterior branch faces. Cyclosystems of at least one sex covered partially or entirely by one or more fixed lids. Coenosteum linear-imbricate and often spinose. Nematopores common, especially on cyclosystem lids, pseudosepta, and ampullae. Gastropore double chambered; gastro- and dactylostyles absent. Ampullae usually superficial and large, occurring in variety of positions and with variety of efferent pore locations. Female ampullae usually occur singly on cyclosystem lid and proximal cyclosystem wall; male ampullae usually clustered, often in a compartmentalized ring around cyclosystem or in cyclosystem lid and proximal cyclosystem wall. Type-species: *Crypthelia pudica* Milne Edwards and Haime, 1849, by monotypy.

*Discussion.*—The description of *C. micropoma* requires a broadening of the generic diagnosis to include species that are sexually dimorphic with regard to lid



development, allowing one sex, the male, to be lacking lids entirely. The very rudimentary lid of the female serves as a continuation of the proximally located ampulla, just as it functions in many other species of *Crypthelia*. On the other hand, in other species of *Crypthelia* the lid is well developed and flat, without an ampullar cavity. The function of these flat lids is presumed to be purely defensive. It is tempting to speculate that the lid first evolved as an extension of the female ampulla from the adjacent proximal cyclosystem wall, as it is in *C. micropoma*, and later developed into a broader canopy, which often supports the female ampulla as well as serving as a defensive barrier to predators.

In most species of *Crypthelia* there is a large cylindrical cavity about 0.1 mm in diameter running along the branch axis (Fig. 28). This structure appears to be unique to the genus *Crypthelia* and is herein termed the central canal.

*Crypthelia micropoma*, new species

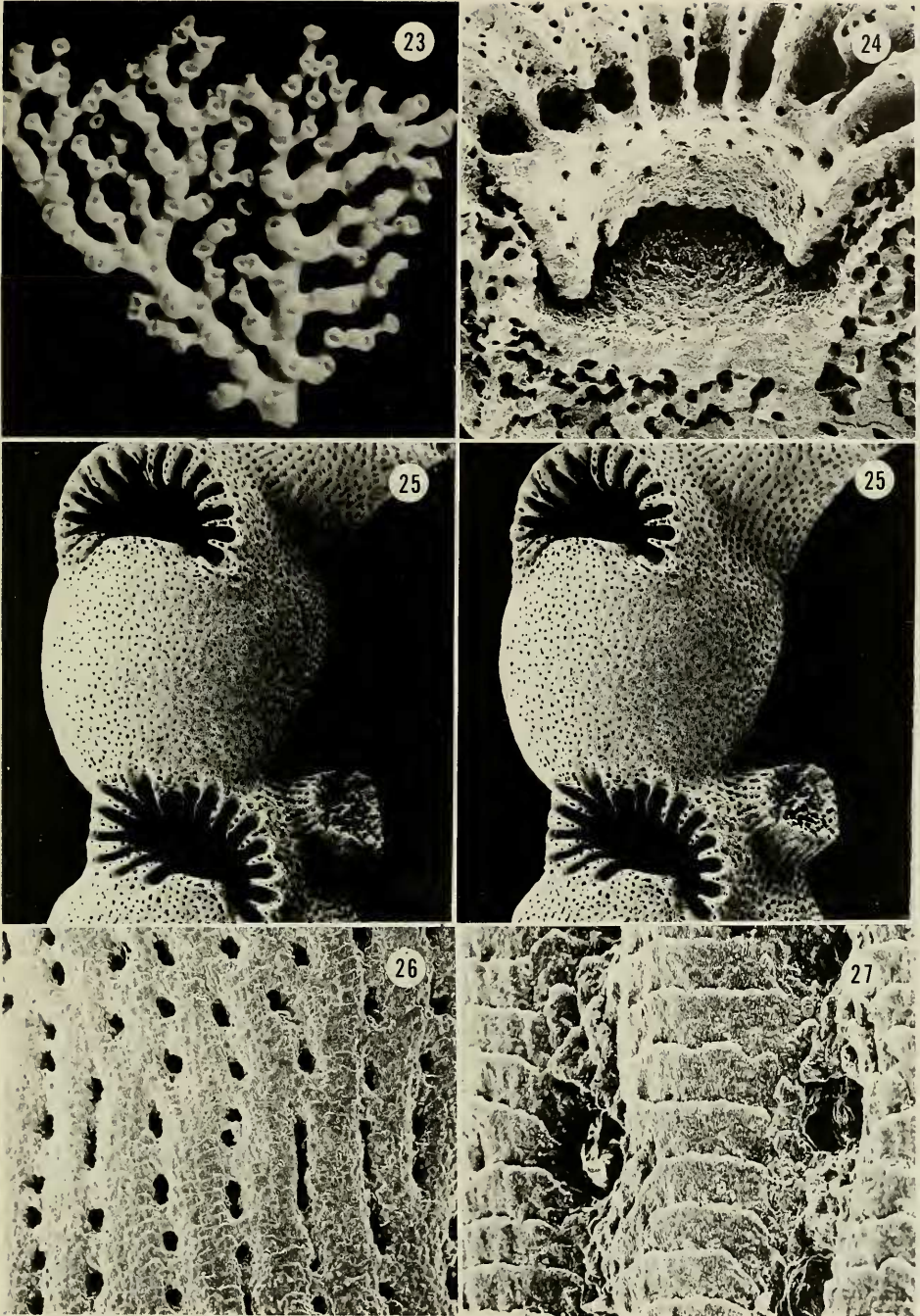
Figs. 23–31

*Description.* — Largest colony (holotype) 36.2 mm tall and 38.8 mm broad, with a basal branch diameter of 3.1 mm. Branches moderately anastomotic. Central canal about 0.1 mm in diameter. Coenosteum composed of linear-imbricate strips 50–90  $\mu\text{m}$  broad bordered by thin discontinuous slits about 9  $\mu\text{m}$  wide. Platelets broad (each extending across width of strip), slightly convex, and longitudinally ridged; not spinose. Nematopores absent.

Cyclosystems elliptical to irregular in outline, a typical cyclosystem  $1.7 \times 1.2$  mm in diameter. There is sexual dimorphism regarding number of dactylopores per cyclosystem. Based on 25 female cyclosystems, there was a range of 14–21 dactylopores per cyclosystem, average = 18.20 ( $\sigma = 1.78$ ), and mode = 19. Of 25 male cyclosystems, there was a range of 20–24 dactylopores per cyclosystem, average = 21.00 ( $\sigma = 1.15$ ), and mode of 20.

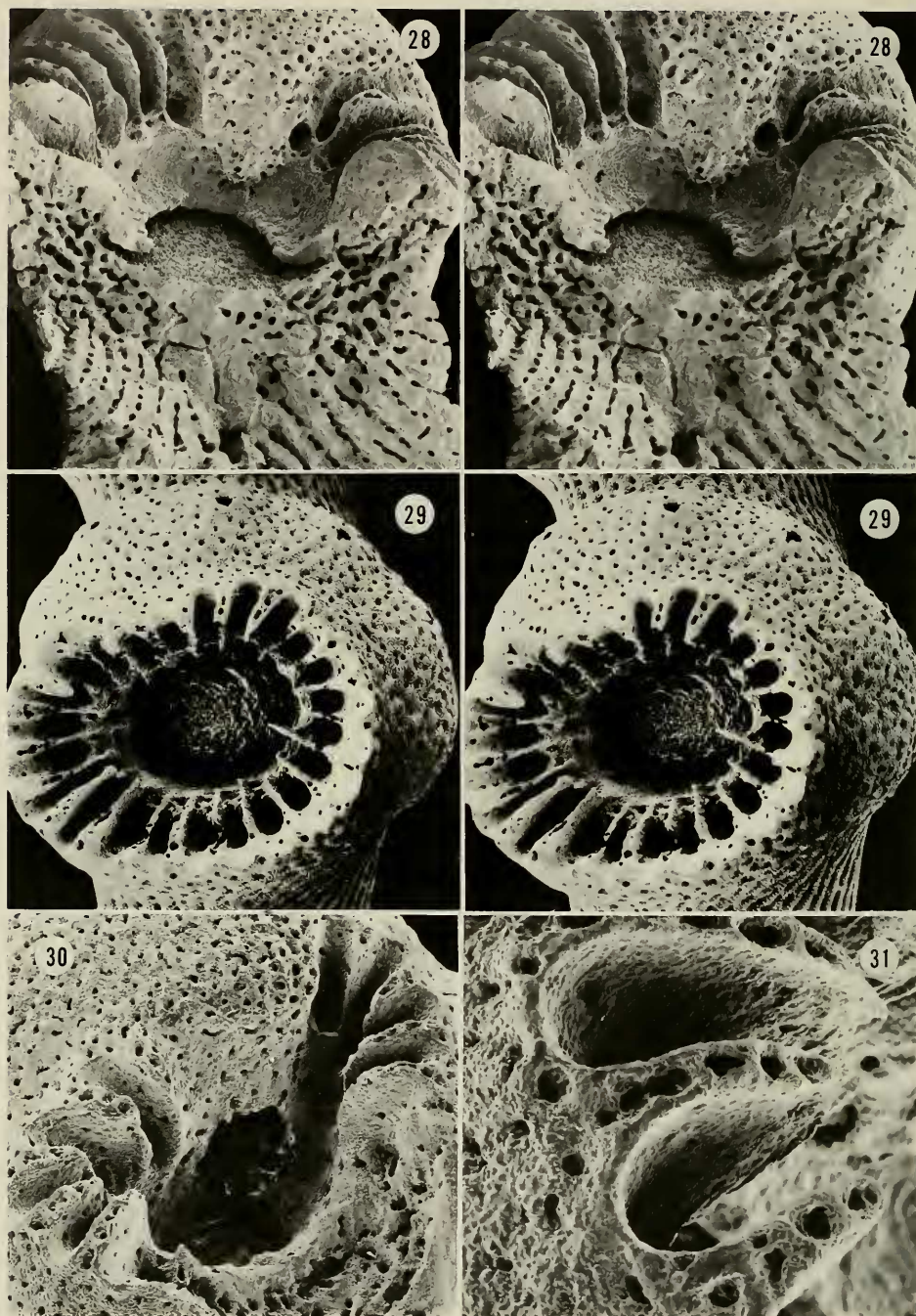
Upper gastropore chamber spherical, about 0.65 mm in diameter; aperture to lower chamber about 0.50 mm in diameter; lower chamber flat and broad, about 0.85 mm wide and 68  $\mu\text{m}$  tall (Fig. 28). Floor of lower chamber spinose, spines up to 25  $\mu\text{m}$  tall and 5  $\mu\text{m}$  in diameter. Cyclosystem lid present only on female cyclosystems having large ampullae. These lids small, triangular to rectangular, covering only a small part of cyclosystem. Lids 2 to 5 pseudosepta in width, explaining why there are slightly fewer dactylopores per cyclosystem on female cyclosystems. Dactylopore slits 0.11–0.13 mm wide. Within each dactylopore is an amorphous skeletal secretion attached to all sides of the pore, which can be clearly seen in an undamaged cyclosystem. This structure is not considered to be a dactylostyle. Pseudosepta slender, 0.80–0.90 mm wide at outer edge, narrowing to about 45  $\mu\text{m}$  width at inner edge. Upper pseudoseptal edges slightly concave and very porous.

Female ampullae massive irregular spheres up to 2.2 mm in diameter located in proximal cyclosystem wall and branch coenosteum proximal to cyclosystem. Female efferent pores up to 0.33 mm in diameter, opening into upper gastropore chamber adjacent to lid (Fig. 30). Male ampullae about 0.60 mm in diameter, occurring unilinearly or slightly alternating in an incomplete ring surrounding a cyclosystem. Up to 12 ampullae may encircle a cyclosystem, the first ampullae occurring in the proximal cyclosystem wall region, with subsequent ampullae



Figs. 23–27. *Crypthelia micropoma*. (23, Holotype; 24–27, female paratype from Anton Bruun 8-420A): 23, Holotype colony,  $\times 1.65$ ; 24, Longitudinal section of cyclosystem,  $\times 45$ ; 25, Female cyclosystems,  $\times 17$ , stereo pair; 26–27, Imbricate coenosteum,  $\times 97$ ,  $\times 375$ , respectively.





Figs. 28–31. *Cryptothelia micropoma*. (28, 30–31, female paratype from Anton Bruun 8-420A; 29, male paratype from Anton Bruun 8-420A): 28, Longitudinal section of female cyclosystem showing spiny lower chamber and central canal (lower center),  $\times 32$ , stereo pair; 29, Cyclosystem surrounded by male ampullae,  $\times 29$ , stereo pair; 30, Damaged cyclosystem revealing female efferent pore just beneath rudimentary lid,  $\times 39$ ; 31, Porous pseudosepta,  $\times 125$ .

occurring on either side leading toward the distal cyclosystem edge. Male efferent pores apical and flush with surface, about 60  $\mu\text{m}$  in diameter.

Large nematocysts  $17 \times 3 \mu\text{m}$  occur individually in the coenosarc and in clusters in the pseudosepta, but not concentrated in nematophores. Dactylozoid nematocysts about  $6.0 \times 2.5 \mu\text{m}$ .

*Discussion.* — *Crypthelia micropoma* is distinguished from the other 15 known species in the genus (Cairns 1983b) by two unique features: 1) only mature female cyclosystems have lids, male cyclosystems do not have lids, and 2) the dactylopores contain a spongy deposit of calcium carbonate. Other characteristics of *C. micropoma* shared with only one or two other species in the genus are its lack of nematopores, and its porous upper pseudosepta, and spiny lower gastropore chamber.

Because of its very inconspicuous lids, *C. micropoma* is superficially similar to *Conopora*, a slightly less derived cyclosystemate genus having a double-chambered gastropore and lacking gastro- and dactylostyles (Cairns 1983a, 1984). However, it is clearly more derived than *Conopora* based on its: 1) unifacially arranged cyclosystems, 2) more highly integrated female ampullae (having one ampulla per cyclosystem and efferent pores opening into the upper gastropore chamber), and 3) cyclosystem lid, present on at least some of the female cyclosystems.

*Etymology.* — The specific name *micropoma* (Greek *micro*s for “small” + *poma* for “lid”) refers to the rudimentary cyclosystem lids of this species.

*Types.* — Holotype: Anton Bruun 8-420A, female, USNM 72353. — Paratypes: Anton Bruun 8-420A (1 female colony, 1 male colony) USNM 72354, (1 male branch) BM 1985.00.00.00. Type-locality: 2°42'S, 40°53'E (off Malindi, Kenya), 140 m.

*Distribution.* — Known only from the type-locality.

### Acknowledgments

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### Literature Cited

- Boschma, H. 1963. On the stylasterine genus *Errina*, with the description of a new species. — Proceedings Koninklijke Nederlandse Akademie van Wetenschappen (C)66(4):331–344, 1 pl.
- Cairns, S. D. 1983a. Antarctic and Subantarctic Stylasterina (Coelenterata: Hydrozoa). — Antarctic Research Series 38:61–164, 50 pls.
- . 1983b. A generic revision of the Stylasterina (Coelenterata: Hydrozoa). Part 1. Description of the genera. — Bulletin of Marine Science 33(2):427–508, 28 pls.
- . 1984. A generic revision of the Stylasteridae (Coelenterata: Hydrozoa). Part 2. Phylogenetic analysis. — Bulletin of Marine Science 35(1):38–53, 4 figs.
- . [In press, a]. A revision of the Northwest Atlantic Stylasteridae (Coelenterata: Hydrozoa). — Smithsonian Contributions to Zoology.
- . [In press, b]. Stylasteridae (Hydrozoa: Hydroida) of the Galápagos Islands. — Smithsonian Contributions to Zoology.

Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.